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APOGEE PEAK OF FLIGHT NEWSLETTER

New Release of AeroCFD software

AeroCFD just got twice as easy to operate, 30% faster, and 100 times more useful!

AeroCFD is the software that allows you to find information about your model rocket that wasn't previously available - except with the use of complex and expensive wind tunnel testing. We think of it as a wind tunnel in your computer!

The flight of a rocket is highly complex, and it takes a sophisticated software like AeroCFD to sort it all out. For example, as a rocket takes off in the real world, its speed and angle-of-attack are constantly changing. When these change, parameters like the coefficient of drag and the CP location are constantly changing too. AeroCFD can tell you all about these changes at any subsonic speed and any angle-of-attack.

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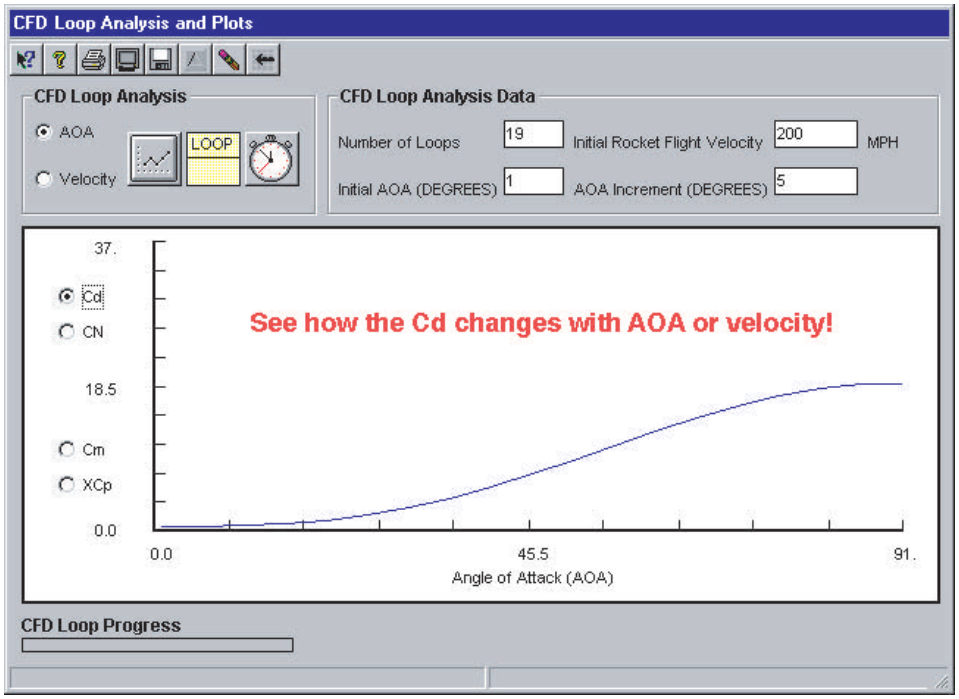

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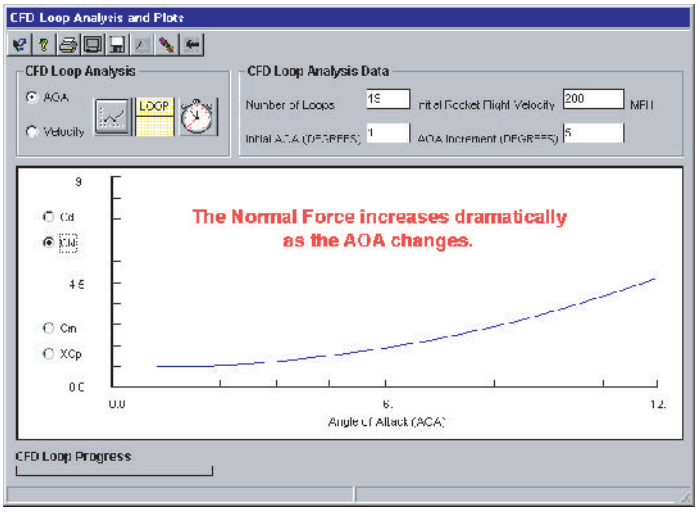
New Release of AeroCFD software - cont. from cover

- AeroCFD is able to chart these changes through a process called computational fluid dynamics. It sounds complex, and deep down, it is. But you don't need to worry about that. AeroCFD displays the results in a simple-to-use graph. If you've used the graphs in other rocketry programs, you'll have no problems extracting the information that is important to your model's flight.

And AeroCFD v3.6.1 is now even more powerful than previous versions. The big new feature that a lot of users requested is the ability to perform looping simulations - so that you can find the shift in the CP or the Cd as the angle-of-attack of the rocket changes. You no longer have to perform multiple independent simulations to get the results. And the data can be printed or exported out of the software to be used in other programs! The same loop feature can also be applied to the speed of the rocket -- so you can find how the Cd of your model changes as it flies faster. The looping feature takes a little longer to run simulations, so it was also compiled to the C++ programming language. This makes the program run simulations at least 30% faster. This new version now allows any shape body tube; so you can put multiple transitions sections along the length of the body. This is controlled in an easy to use "Free-Form" body tube editor screen. With this feature, you can model really complex models.

Major enhancements were also made to the user interface to make the program much easier to use. You'll find it much easier to define the shape of the rocket, so that you can get results quicker. And the displays have been modified so that you'll find the most important data on the main screen.



Actual screenshot from AeroCFD

Version 3.6.1 incorporates the following changes:

1) New simplified layout allows the user to define geometry and perform CFD analyses quickly and easily.

2) Perform fin and nose-body CFD analyses on the main screen with a single click of the Solve command button. Then, see Cd, CN, and CM displayed on the main screen when analysis is complete. All drag coefficients continue to be displayed on the main screen.

3) Define Standard Geometry body tube shapes and Free-Form body tube shapes on separate screens that return to the main analysis screen when data entry is complete.

4) Generate axi-symmetric body tube shapes using the new Free-Form method. The user simply defines the total number of points describing half the body tube and then generate any arbitrary shape by dragging the points into position with the mouse.

5) Perform up to 360 CFD Looping analyses and generate Cd, CN, CM and XCp as a function of angle of attack (AOA) or velocity by specifying initial conditions and increments. Save data in comma-delimited text format or print data directly to the printer.

6) Plot Barrowman Equation CN, CM and XCp for Standard Geometry with results plotted by the CFD Looping analysis.

7) Read older AeroCFD data files and convert them into AeroCFD 3.6 format.

8) Direct display of Drag forces acting on nose-body tube, fins, and launch lugs. In addition, direct display of lift force acting on the fins at some specified angle of attack.

9) On the main analysis screen the total drag coefficient (Cd) referenced to the area at the base of the nose cone is displayed. In addition, the total drag coefficient (Cd) referenced to the maximum cross-sectional area of the rocket is displayed for comparison.

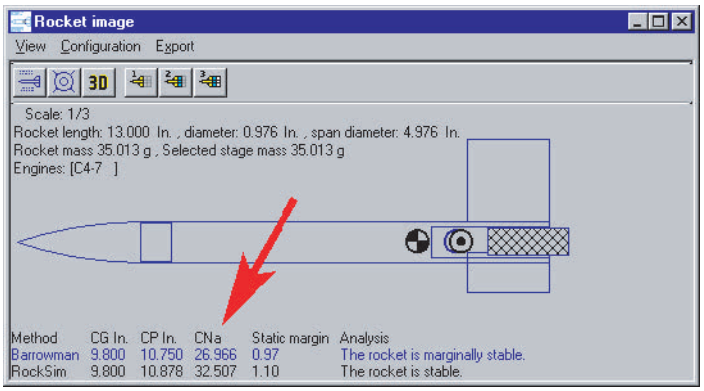
10) AeroCFD 3.6 is compiled in C++ native code for a speed increase of 25 percent to 30 percent.

This new version is now available. The new price is $65 - which is a huge bargain for such powerful software. To do what AeroCFD can do, you'd have to spend over $4000 on expensive, hard-to-understand software. If you have previous versions of AeroCFD, the upgrade to version 3.6 is only $15. For details or to order, visit the Apogee Components web site at:
http://www.apogeerockets.com/aerocfd.asp *-APOGEE*

What is "CNa?" Part 1 of 2

By Tim Van Milligan

Every now and then, I get a question from a new user of RockSim regarding that strange number on the bottom of the summary screen called: "CNa." It is in the stability area, listed right next to the CP location and the Static Margin. Since it is in this location, many new users think that it must be very important, or we wouldn't have put it in such a prominent place.



To be honest, the reason the CNa value is listed on the main page of RockSim is for debugging purposes. Paul Fossey, the programmer of RockSim, put it there so he could quickly find out if software was calculating the "RockSim Stability Method" correctly. By comparing it to the Barrowman Method, it is possible to see if any huge errors are being made.

If you are using RockSim to simply see if your rocket is stable, then you don't really need to see the CNa number. Just look at the CP location and the CG position. If the CG is forward of the CP, then the rocket will be stable. In future versions of the program, we'll probably put the CNa number in a different location where it doesn't cause so much confusion.

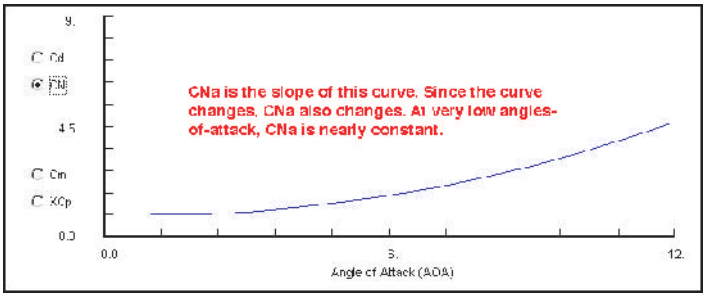
But I do get questions from people asking what it is, and what it is used for. So the rest of this article will be a little more technical as I attempt to describe what it is.

To begin our discussion of CNa, let's first state it's definition. I took out my copy of "Topics in Advanced Model Rocketry" by Mandell, Caporaso, & Bengen, and found this description:

"Barrowman's method (of determining stability) is based on the concept of the normal force coefficient, CNa, a dimensionless number dependent upon the shape of the rocket which permits the calculation of the force acting in a direction perpendicular to the rocket's longitudinal axis whenever it is displaced from the direction of the relative airstream by some 'angle of attack' (a pitching or yawing angle)."

In other words, we can find the actual "force" acting on the rocket once we know the CNa of the model, it's speed, the reference area, and the angle of attack at which it is flying.

CNa, which is properly pronounced "CN-alpha," is the local slope of the CN (lift) versus angle-of-attack (AOA) curve. CN is the normal force coefficient acting on the fins and the body, and is derived from CNa by multiplying by AOA in radians.



The total "Force" acting on the rocket is computed by multiplying CN by 0.5*RHO*U^2*Aref.
Where RHO is the density of the air.
U is the velocity of the rocket
Aref is the reference area of the rocket - usually taken as the area of the base of the nose cone.

There are a few ways to find the CNa number for a rocket. The first is to use the Barrowman Equations. This is probably the simplest way; and is the method most computer programs use. RockSim uses this method. By the way, if your interested in computing it longhand, the Barrowman report can be downloaded from the Apogee Components web site at:

http://www.apogeerockets.com/education/downloads/Barrowman_report.pdf

-Cont. on page 4

About this Newsletter - Apogee Components Rocketry E-Zine Newsletter is a FREE optional newsletter about model rocketry. We have, and we'll continue to discuss a lot of different rocketry topics, including: rocket design philosophy, computer simulations, construction techniques, rocketry in education, happenings in the rocket industry, competition strategies, and new product announcements.

What is "CNa?" - cont from pg 3

When performing the math, you find the CNa of the nose, then the CNa of the body, plus the CNa of the fins, etc. Then is is simply a matter of adding up all the values to find the Total CNa of the rocket.

The next way to find the CNa of the model is to stick it into a wind tunnel and actually measure the forces on the rocket. Then you back out the CNa once you know the slope of the CN versus AOA curve. This is the most accurate way to determine the number. However, since most modelers don't have wind tunnels, it isn't likely that you'll be able to test your models directly.

One problem associated with wind tunnels comes with small rockets flying at very low angles of attack. The forces on the rocket are very tiny, and they aren't easily measured by wind tunnels. Any air turbulence in the tunnel will compound the problem by orders of magnitude. Good low-speed wind tunnels are expensive because so much effort is made to eliminate any turbulence in the flow stream. And very sensitive (i.e., "expensive") instrumentation must be used to measure the small forces.

A third way is to use the AeroCFD software. As I've mentioned many times before, this particular software is like a wind tunnel inside your computer. It computes the flow of air particles moving past the rocket, so it can determine the forces on the model. From the overall forces, it backs out the CNa, just like is done with an actual wind tunnel.

There is a small problem associated with AeroCFD that is similar to wind tunnels. At very low angles of attack (under 3 degrees) and at very low flight speeds, the forces on the rocket are very-very tiny. As AeroCFD computes these forces for each cell in the matrix in uses, it can round off the numbers that are very small. This can give erroneous numbers. But as the angle-of-attack climbs, the forces increase and AeroCFD results becomes much more accurate.

The good news is that at low angles of attack, CNa is fairly constant. That is why the Barrowman Equations are useful. So the best solution for modelers is to use a combination of the Barrowman Equations at very low angle of attack, and AeroCFD at higher flight angles.

The advantage that AeroCFD has in determining CNa, is that it does not follow the simplifying assumptions that the Barrowman Equations require. The most important one being that in the Barrowman Equations, the rocket must be at low angles of attack. The Barrowman equations aren't valid at high angles of attack - while AeroCFD becomes much more accurate.

For the most part, models usually fly within the low angles of attack, and so the Barrowman Equations are just fine. That is why RockSim and other static stability programs work, and most rockets designed using them will be stable.

But if your rocket is flying in windy conditions, the Barrowman Equations may be violated. In this case, you should use AeroCFD. It can calculate the forces at any angle of attack.

In the next issue, I'll go through some simple examples, and try to give additional insight into the CNa term.

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He is also the author of the books: "Model Rocket Design and Construction," "69 Simple Science Fair Projects with Model Rockets: Aeronautics" and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to this e-zine at the Apogee Components web site, or sending any message to:
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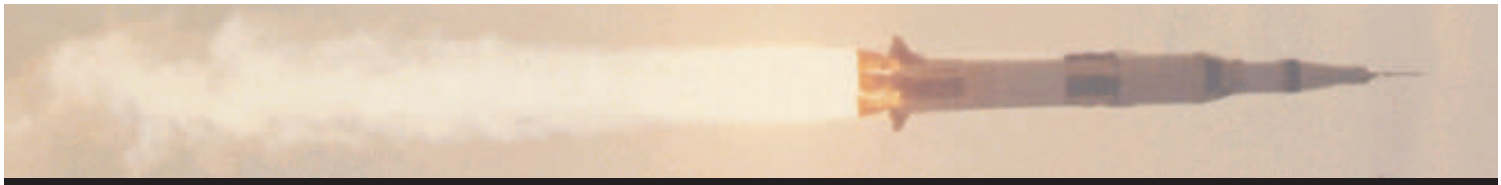


The first step into space is a model rocket.

What is "Better?" - A follow-up report

In the last issue of the Apogee e-zine newsletter, I asked for comments and suggestions regarding what criteria should be used when computing minimum lift-off speed. So far, I have only gotten one reply. If you still have comments, please send them to me at:
tvm@apogeerockets.com

Here is the message from Mark Peters:

Relating to your request for input on minimum take-off speed, recognize that a significant factor is the length of the launch rods in widespread use. An airframe will maintain an acceptable trajectory while attached to the guide rail regardless of acceleration at launch. I am continually frustrated by the industry's default mandate of a three to four foot 0.125" dia. launch rod for model rockets just because that is a readily obtainable single length for piano wire. Much longer segmented rods with threaded end connections are entirely practical such as that used for portable gun cleaning rods. Wouldn't most rocketeers agree that the slowest possible take-off is more realistic and satisfying provided the model achieves some semblance of aerodynamic stability once it departs the guided phase of launch?

I wish to argue in favor of the slowest possible lift-off speed that would ensure stability after accelerating a distance of at least seven to eight feet instead of the usual 30 to 40 inches! Increase the acceptable lift-off mass of a model for any given initial thrust of engine specified. Recommend instead a greatly increased length to the launch rod or guidance component of a system. Most better launch pads will pivot a rod to an acceptable height for engaging the launch lugs or could be easily separated at mid length or even at the bottom for placing a rocket on the pad. This opinion offers an alternative win-win solution to the problem discussed; but will I suspect remain hugely unpopular due to existing launch equipment that could be improved instead of focusing on limited rocket lift-off mass. Please keep this in mind especially when recommending nose weight addition for the upcoming release of your Saturn 1B scale model. It is perfectly viable to specify a substantially increased length and perhaps diameter to the launch rod instead of merely adding excess mass to the nose to achieve flight stability after a somewhat limited acceleration distance. I personally intend to use at least an eight foot multi-segmented launch wire and aim to decrease nose weight addition, thereby maximizing altitude performance with the thrust profiles available.

Mark Peters *-APOGEE*

Bring the space race to your neighborhood order your APOGEE SATURN V and SATURN 1B TODAY!

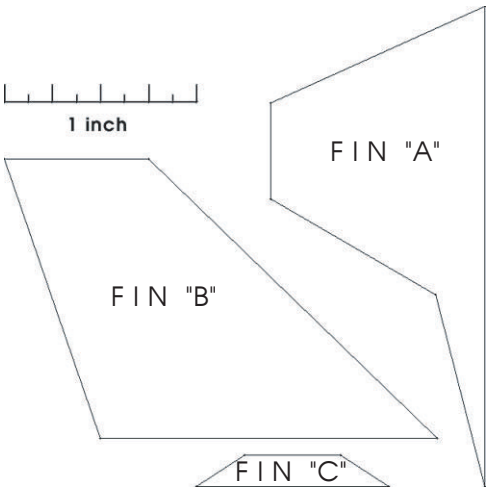
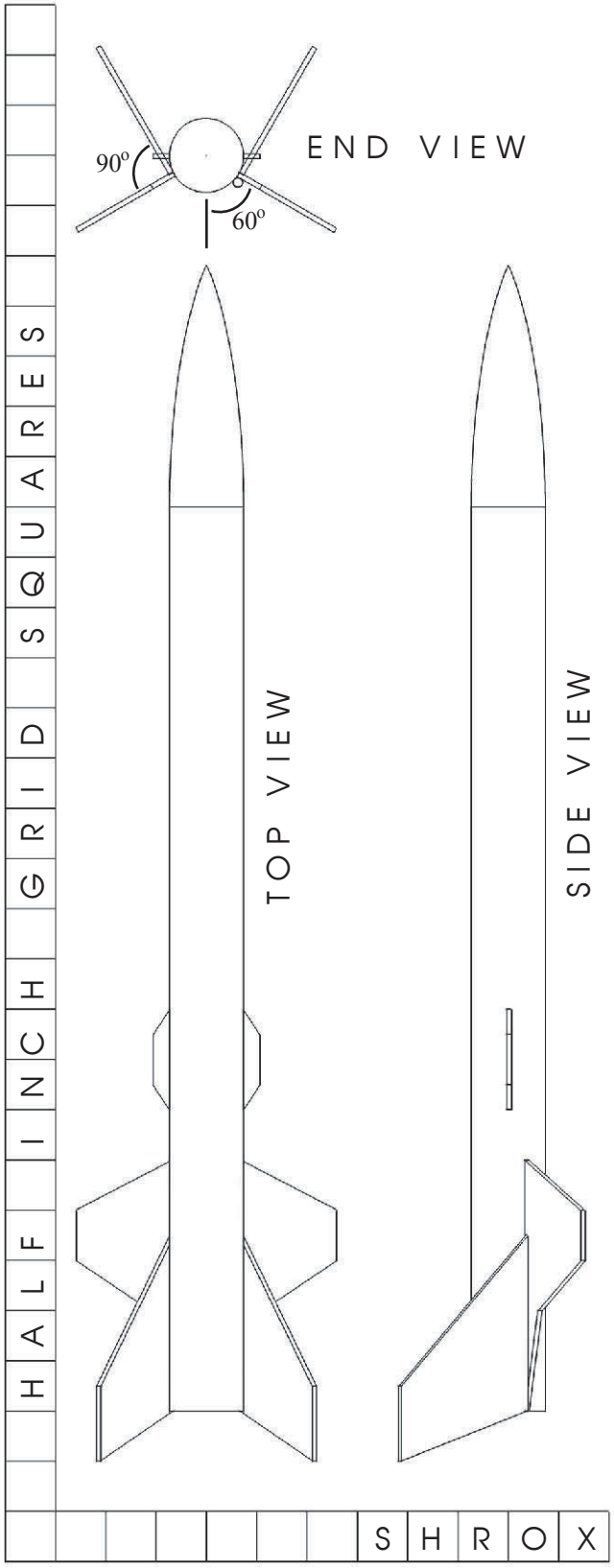
FREE ROCKET PLAN!

SHX/TVM-01

A fun little flyer by Shrox that is a great introduction to balancing principles of aerodynamics with aesthethically pleasing design. Try it on a C6-5.

These are the parts you will need:

1) P/N 10099 Airframe Tube 24 - 9 in. long
1) P/N 19400 24mm nosecone (plastic)
1) C engine mount
- 2) P/N 13031 18-24 Centering rings
- 1) P/N 13029 13-18 Centering ring
- 1) P/N 10062 Airframe Tube 18 - 2 1/2 in. long
1) P/N 13051 Launch lug
1) P/N 29005 3 ft. Streamer
1) P/N 29505 Kevlar 8 in. line
1) 14 in. Shock cord and mount
3/32 in. Fin stock (balsa, basswood, or heavy card stock)

Note: It is assumed you have built at least two rockets before this and can build common assemblies without exact direction.

Review the drawings awhile before starting. Heck, enjoy your favorite beverage as well, have snack, then wash your hands.
Now let's begin. Assemble and install the motor mount. Cut out 2 sets of the fins from your chosen fin stock. Using the drawings for reference, attach the fins using the end view as a guide for alignment. Attach the "A" fins first, Then set the "B" fins as shown according to the drawings. Then the "C" fins, set these 3" forward of the rear of the body tube. Then attach the launch lug underneath fin "A" so it is about 1/2" from the leading edge. Finally install the streamer and streamer mount. Pack some wadding, load a motor, let's go!